Original Article

Assessment of Severity of Malnutrition in Peritoneal Dialysis Patients via Malnutrition: Inflammatory Score

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Abstract

Background: Regarding to the complications of malnutrition in dialysis patients, using an easy and reliable method for evaluating of malnutrition is important in patients with the end-stage renal disease. Based on the effect of inflammatory factors in malnutrition, A new scale has been designed which is called malnutrition–inflammatory scale (MIS). We designed current study to assess the severity of malnutrition in peritoneal dialysis patients in Isfahan via MIS. **Materials and Methods:** In this cross-sectional MIS was used for evaluation of malnutrition. MIS includes 10 components: dry weight changes, dietary intake, functional capacity, comorbidity, muscle wasting and loss of subcutaneous fat as well as body mass index (BMI), serum albumin level and total iron binding capacity (TIBC). Each component has four levels of severity from 0 (normal) to 3 (severely abnormal). All analyses were performed using Statistical Package for Social Sciences version 20 (SPSS 20) and $P < 0.05$ were considered statistically significant. **Results:** Results showed no significant difference in MIS between male and female participants. Mean of minimum inhibitory concentration in this study was calculated about 4.1 (MIS <9) which means no or mild malnutrition. Significant correlation between MIS and weight ($P < 0.001$), BMI ($P < 0.001$), TIBC ($P < 0.001$), triglyseride ($P = 0.04$) and arm circumference ($P < 0.001$) was seen. **Conclusion:** We suggest That MIS is being used as a valuable tool for prevention of fatal outcomes in chronic dialysis patients.

Keywords: *End-stage renal disease, malnutrition, malnutrition-inflammation score, peritoneal dialysis*

Introduction

Malnutrition occurs in about one-third of patients with end-stage renal disease (ESRD) who undergo peritoneal dialysis. Malnutrition in chronic dialysis patients may be due to poor nutritional intake, excessive losses, increased protein catabolism, and acidosis.[1-6]

Moreover, inflammation and inflammatory factors have an important role in malnutrition in patients with ESRD.[3,7-10]

Recent studies have shown that ESRD patients with malnutrition have higher hospitalization and mortality rate and are more susceptible to infections, fatigue, and poor rehabilitation.[3,10,11]

Regarding to the complications of malnutrition in chronic dialysis patients, using an easy and reliable method for evaluating of malnutrition is important in patients with ESRD who are undergoing peritoneal dialysis.[3,10]

Until now, different methods for measuring of nutritional status in dialysis patients, have been designed, from the simple methods such as anthropometric measurements or change in serum albumin concentration to expensive methods like dual-energy X-ray absorptiometry which is not routinely used.[3,12,13]

A reliable and suitable method which has been used as a scale for assessment of nutritional status in dialysis patient in different studies is a subjective global assessment (SGA).[13] In spite of reliability and practicality, SGA has not sufficient sensitivity for assessment of small changes in nutritional status.[14]

Based on the effect of inflammatory factors in malnutrition, Kalantar-Zadeh *et al*. have designed a new scale which is called malnutrition–inflammatory scale (MIS).[15]

Regarding the importance of malnutrition in patients undergoing peritoneal dialysis

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and lack of any previous study on nutritional status in such patients in Isfahan, we designed current study to assess the severity of malnutrition in peritoneal dialysis patients in Isfahan via MIS.

Materials and Methods

This cross-sectional, descriptive-analytic study was conducted at Nephrology Research Center of Isfahan University of Medical sciences, in 2012. The study population were all the ESRD patients who referred for peritoneal dialysis to dialysis centers in Alzahra and Khorshid hospitals in Isfahan and met inclusion criteria of the study.

Inclusion criteria were patients with ESRD who underwent peritoneal dialysis in dialysis centers of Alzahra and Khorshid hospitals.

Patients with a history of hospitalization due to acute infection in the past 1 month, patients who underwent kidney transplantation and patients who changed method of dialysis to hemodialysis, excluded from this study.

This study was approved by the Ethic Committee of Isfahan University of Medical Sciences, and written contests were obtained from all the participants before the study.

MIS was used in this study for evaluation of malnutrition. The reliability of this questionnaires, was reported as ICC = 0.829.([16]). Also, the validity of this scale was shown in previous studies.([16,17]).

MIS includes 10 components: dry weight changes, dietary intake, functional capacity, comorbidity, muscle wasting and loss of subcutaneous fat as well as body mass index (BMI), serum albumin level and total iron binding capacity (TIBC). Each component has a four levels of severity from 0 (normal) to 3 (severely abnormal).

Scoring of these ten components

1. Dry weight changes (weight changes in last 3–6 months): 0 (weight loss <0.5 kg).1 (0.5 kg < weight loss >1 kg).2 (1 < weight loss >5% body weight), 3 (weight loss >5% body weight)
2. Dietry intake: 0 (no change in routine solid diet), 1 (suboptimal solid diet intake), 2 (full liquid diet or moderate decrease in diet intake), 3 (life-threatening decrease in diet intake)
3. Gastrointestinal symptoms: 0 (no symptoms), 1 (mild decrease in appetite or mild nausea), 2 (occasional vomiting accompanied by moderate symptoms like abdominal pain), 3 (intermittent diarrhea or vomiting or severe anorexia)
4. Functional capacity: 0 (normal functional capacity or improvement in functional capacity), 1 (difficulty with ambulating or recurrent fatigue), 2 (difficulty with independent activities), 3 (limitation in light activity or bed/chair ridden with no or little physical activity)
5. Comorbidities: 0 (on dialysis <1 year and healthy otherwise), 1 (on dialysis for 1–4 years or mild co-morbidity, [no major comorbid conditions [MCC], 2 [on dialysis more than 4 years or moderate comorbidity [one MCC]],3 [Any severe, multiple co-morbidity [two or more MCC]])
   MCC include congestive heart failure class III or IV, severe coronary artery diseases, moderate to severe chronic obstructive pulmonary diseases, full-blown AIDS, major neurological sequlaes, metastatic malignancies or recent chemotherapy
6. Loss of subcutaneous fat which is measured in two points, biceps and triceps muscles: 0 (normal or no change), 1 (mild), 2 (moderate), 3 (severe).
7. Signs of muscle wasting which is measured in two parts of body: quadriceps muscle and interosseous muscles: 0 (normal or no change), 1 (mild), 2 (moderate), 3 (severe)
8. BMI or BMI = weight (kg)/height² (m): 0 (≥20), 1 (18–19.99), 2 (16-< BMI > 17.99), 3 (<16)
9. Serum albumin level: 0 (≥4 g/dl), 1 (3.5–9.3 g/dl), 2 (3–3.4 g/dl), 3 (<3 g/dl)
10. TIBC: 0 (≥250 mg/dl), 1 (200–249 mg/dl), 2 (150–199), 3 (<150 mg/dl).

Sum of these scores is between 0 (normal) to 30 (severe malnutrition).

According to several studies, scoring of malnutrition severity in dialysis patients based on MIS, is as below:

- MIS <9: No or mild malnutrition
- MIS = 9–18: Moderate malnutrition
- -MIS >18: Severe malnutrition.[14,15]

Anthropometric measurements

Height, dry body weight, and skinfold thickness (TSF) were measured for all participants. BMI was calculated according to this formula: weight (kg)/height² (m).

TSF at triceps and mid-arm circumference (MAC) were measured using a metal tape and caliper, three times on a nonaccess arm and average measurements were recorded.

Mid-arm muscle circumference (MAMC) was calculated by this formula: MAMC = MAC - (3.1415 × TSF).[3,14]

Laboratory evaluation

Blood samples were taken from all the patients for measuring of these parameters: Serum albumin, blood urea nitrogen (BUN), creatinine (Cr), triglyseride (TG), cholesterol (Cl) and hematocrit and TIBC.

Demographic data including age, gender, height, weight, also underlying diseases which lead to ESRD like diabetes, hypertension (HTN) and gelomerulonephritis, congenital kidney diseases, dialysis fluid and laboratory results were recorded in special questionnaires for each patient.

Kt/V was measured for each patient. It is a number used to quantify hemodialysis and peritoneal dialysis treatment adequacy and was calculated by this formula:

Kt/V = K (dialyzer clearance of urea) *t* (dialysis time)/V (volume of distribution of urea, approximately equal to patient's total body water).

The data presented as mean ± standard deviation for continuous variables and number (percent) for categorical ones. Because of the number of patients, we use the Shapiro–Wilk test for normality. Statistical analysis was assessed using Spearman's rank correlation coefficients. All analyses were performed using Statistical Package for Social Sciences version 20 (SPSS Inc., Chicago, IL, USA) and $P < 0.05$ was considered statistically significant.

Results

A total of 150 eligible patients enrolled in this study. Seventy-seven patients (51.3%) were male and 73 (48.7%), were female. Among studied patients, 65 patients (48.9%) had diabetes mellitus, 47 (35.3%) HTN, 4 (3%) glomerulonephritis, 3 (2.3%) congenital kidney diseases, 1 (0.8%) polycystic kidney disease, and 1 (0, 8%) amyloidosis.

Results of independent samples *t*-test showed no significant difference in MIS between male and female participants. Mean of minimum inhibitory concentration (MIC) in this study was calculated about 4.1 (MIS <9) that means no or mild malnutrition.

Table 1 shows the demographic data of the participants.

Correlation between MIC and patients' parameters has been demonstrated in Table 2.

According to Table 2, there is significant correlation between MIS and weight ($P < 0.001$), BMI ($P < 0.001$), TIBC ($P < 0.001$), TG ($P = 0.04$), and arm circumference ($P < 0.001$) in this study.

No significant relationship was seen among MIS and age ($P = 0.30$), height ($P = 0.83$) dialysis duration ($P = 0.35$), BUN ($P = 0.68$), Cr ($P = 0.76$), Cl ($P = 0.87$), and kt-Score ($P = 0.47$) in our study.

Most of the subjects, 24 patients (18.2%) had MIS = 3, which shows no or mild malnutrition in our patients. Only three patients (2.4%) had MIS = 13–21 (moderate to severe malnutrition) in the current study.

Table 1: Demographic data of participants

Characteristics	Mean±SD
MIS	4.1±3.3
Age (year)	56.4±16.6
Weight (kg)	66.0±16.0
Height (cm)	163.3±11.4
BMI (kg/m^2)	25.6±14.8
Arm circumference (cm)	26.7±4.4
BUN (mg/dl)	48.2±15.2
Cr (mg/dl)	7.4±2.9
Serum albumin (g/dl)	1.66±0.8
Triglyceride (mg/dl)	155.3±99.3
Cholesterol (mg/dl)	169.0±55.9
Kt-score	3.5±14.9
Dialysis duration (month)	10±13.6
DM, *n* (%)	70 (46.7)
HTN, *n* (%)	59 (39.3)
Glumerulonephritis, *n* (%)	4 (2.7)
Congenital kidney diseases, *n* (%)	3 (2)

BMI: Body mass index; DM: Diabetes mellitus; HTN: Hypertension, MIS: Malnutrition inflammatory scale, Cr: Creatinine, SD: Standard deviation, BUN: Blood urea nitrogen

Table 2: Correlation between malnutrition inflammatory scale and demographic, anthropometric, and biochemical characteristics of patients

Demographic, anthropometric, and biochemical characteristics of patients	MIS	
	R	*P*
Age (year)	0.087	0.292
Weight	−0.413	<0.0001
Height	−0.018	0.825
Dialysis duration	0.074	0.370
BUN	−0.031	0.710
Cr	−0.006	0.944
TG	−0.161	0.050
Cholesterol	−0.019	0.820
Arm circumference	−0.435	<0.0001
Kt-score	0.017	0.844
Fail_time	0.034	0.683
Caliper	−0.367	<0.0001

Fail_time: Since the patient's glomerular filtration rate is below 15. *P* values derived from Spearman's rank correlation coefficients analysis, *R*: Spearman's rank correlation coefficients. Cr: Creatinine, BUN: Blood urea nitrogen, MIS: Malnutrition inflammatory scale, TG: Triglyseride

Discussion

Malnutrition occurs in about one-third of patients with ESRDwho undergo peritoneal dialysis.[3] Malnutrition increases morbidity and mortality in ESRD patients who are on peritoneal dialysis, but unfortunately, the nutritional status of these patients is frequently ignored.[3,18]

A reliable and suitable method which has been used as a scale for assessment of nutritional status in dialysis patient in different studies is SGA.[13] In spite of reliability and practicality, SGA has not sufficient sensitivity for assessment of small changes in nutritional status.[14]

Based on the effect of inflammatory factors in malnutrition, Kalantar-Zadeh *et al*. have designed a new scale which is called MIS.[15]

MIS is a scoring system which is strongly correlated with the hospitalization, mortality, nutrition, inflammation, and anemia. MIS may be a reliable method for assessment of nutritional status of chronic dialysis patients who are on peritoneal dialysis and may indicate patients at high risk for morbidity and mortality.[14,15]

Serum albumin level is the most important and strongest laboratory predictor of mortality in ESRD patients and hypoalbuminemia reveals poor nutrition and inflammation.[3,14]

In the current study which is the first study on the severity of malnutrition in dialysis patients in Isfahan, we found that most of the peritoneal dialysis patients (90.3%) had no or mild malnutrition (MIS <9) and only 0.8% had severe malnutrition (MIS >18).

Our results also showed that malnutrition in ESRD patients who are undergoing peritoneal dialysis significantly correlates with weight, BMI, TIBC, and arm circumference.

Kalantar-Zadeh *et al*. showed a significant correlation between MIS and weight, BMI, serum albumin, Cr, TIBC, duration of dialysis and age.[14]

Afshar *et al*. reported a significant correlation between MIS and serum albumin level and BMI[3] but did not find any relationship between MIS and age and duration of dialysis.

Similar to Kalantar-Zadeh *et al*. study, we reported a significant correlation between MIS and weight, BMI, and TIBC, but we did not find any correlation between MIS with age and duration of dialysis.

Our results were similar to Afshar *et al*. study results in significant correlation among MIS with BMI and like ours, they did not find any correlation among MIS and age or duration of dialysis.[3] Such difference between current study and Afshar *et al*. study with Klantar-Zadeh *et al*. in the correlation between MIS and age or MIS and duration of dialysis, may be because of difference in duration of dialysis in these studies and mean of the age of participants.

Results of both our study and Kalantar-Zadeh *et al*. show a significant correlation between malnutrition and serum albumin level.[14]

Similar to their study, we reported significant correlation between MIS and weight, BMI, and TIBC, but we did not find any correlation between MIS with age and duration of dialysis.

Conclusion

As MIS is a reliable method for assessing of inflammation and malnutrition which are two important indicators of poor outcome and mortality in dialysis patients and evaluation of nutritional status of ESRD patients through MIS can prevent from poor outcomes, we suggest that MIS is being used as a valuable tool for prevention of fatal outcomes in chronic dialysis patients. Our study had limitations like small sample size and short duration of evaluation, further studies with larger sample size conducted over longer duration are suggested.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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